

# Optimizing Strategies to Sample the Tropical Cyclone Warm Core & Warm Core Transitions During HS3

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# *In-Situ* Whole-Column Warm Core Sampling – Vertical Structure

- Hawkins & Imbembo (1976) – Inez, 1966
- Franklin et al. (1988) – Gloria,
- Halverson et al. (2006) – Erin, 2001

JANUARY 2006

HALVERSON ET AL.

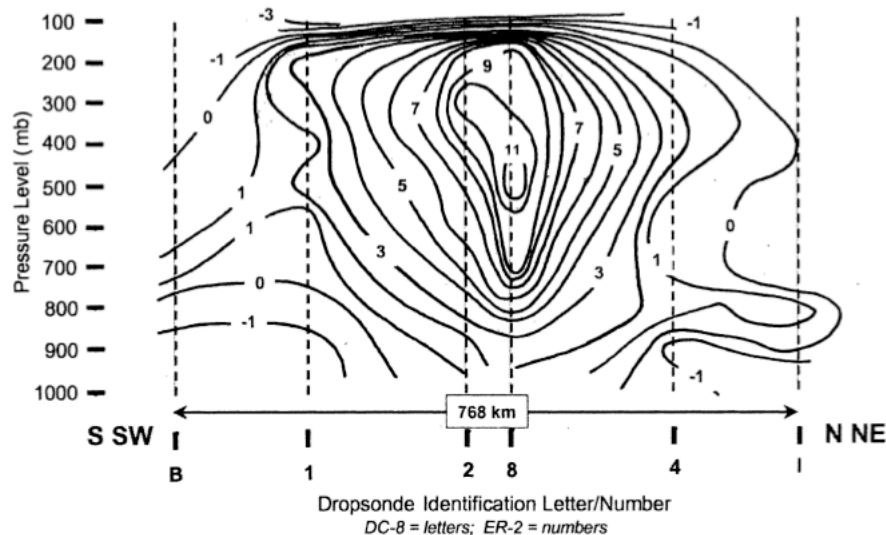


FIG. 6. Cross section through Erin's core showing temperature perturbation. Analysis was made by compositing dropsondes along/nearby the dashed line shown in Fig. 1. The vertical slide is oriented from southwest to northeast. Maximum perturbation temperature of  $+11^{\circ}\text{C}$  and distance scale are shown. Initial release times of dropsondes are 1629, 1648, 1704, 1750, 1928, and 1936 UTC for B, 1, 2, 4, 8, and 1, respectively.

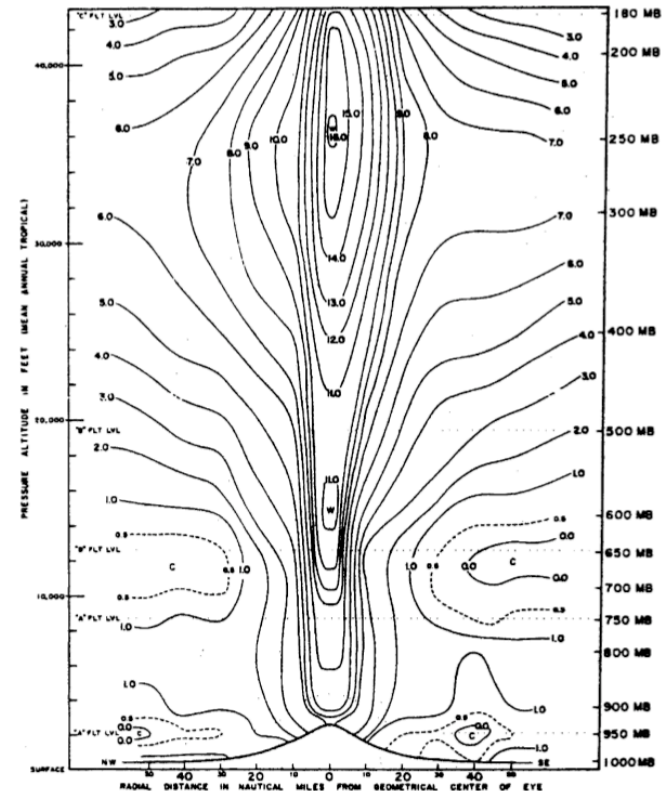
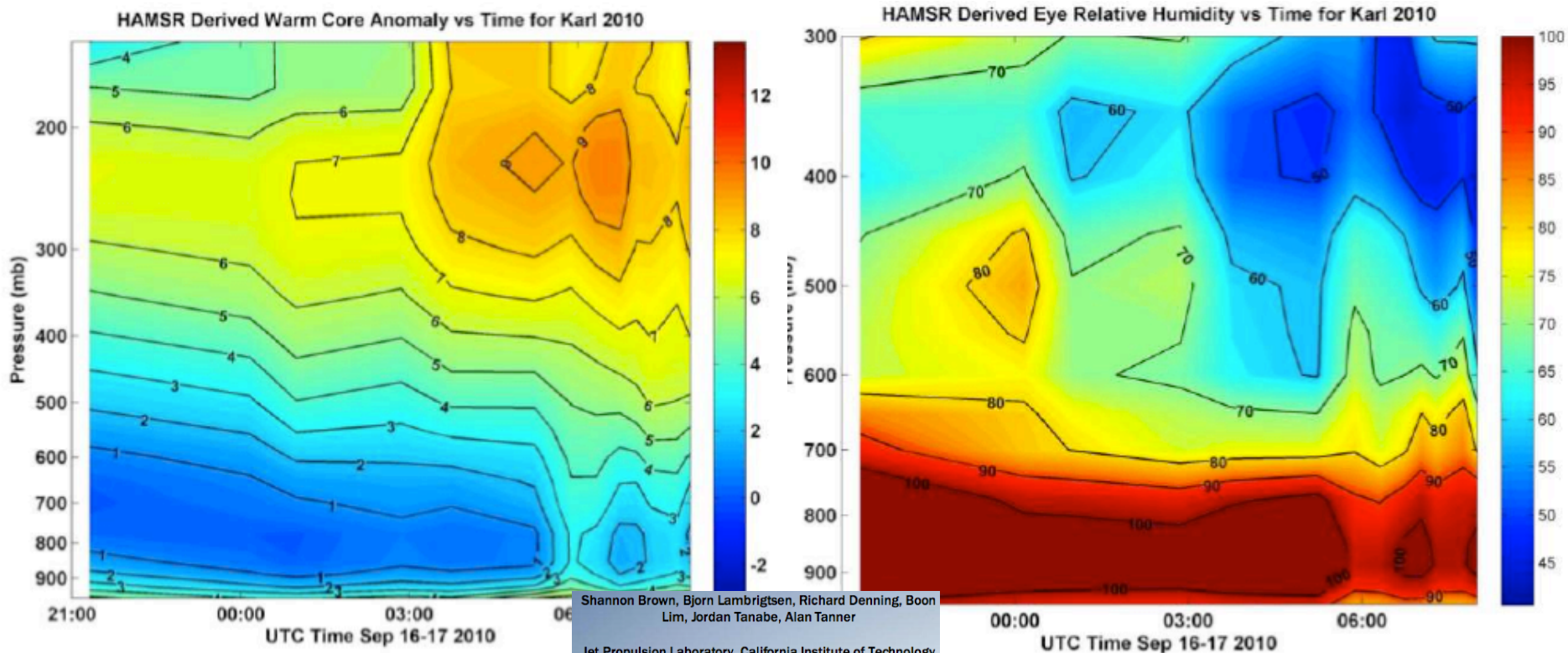


FIG. 8. Vertical section through the inner core of Hurricane Inez, showing isolines of perturbation temperature, based on aircraft transects. Figure reproduced from Hawkins and Imbembo (1976).

# 2010, GRIP: HAMSR Retrievals of Karl's Warm Core During RI

- Unprecedented temporal sampling
- Capable of resolving significant vertical structure



# 2012-2014, HS3: Warm Core Sampling in Variety of TC Environments & Transitions – HAMSR, dropsondes

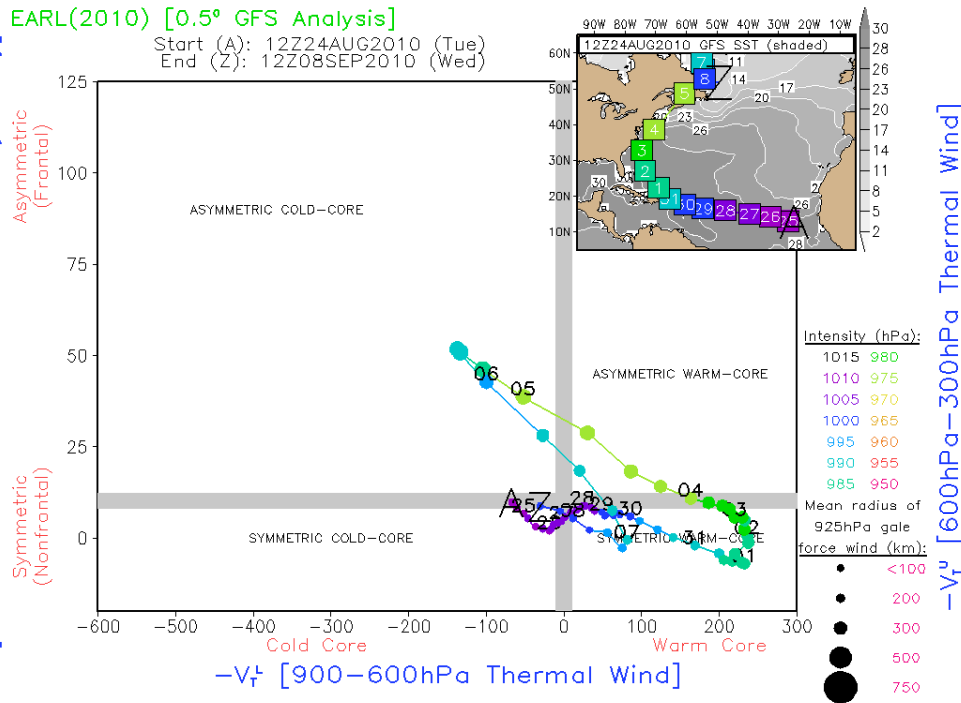
## Key Science Questions Over TC Lifecycle

- Wave to depression transition: Document cold core to warm core evolution; is development bottom-up or top-down? Are there multiple warm cores that consolidate?
- Intensification, RI: Is this dominated by upper level warm core amplification & expansion? What is relationship of warming to subsidence driven by convective bursts, latent heating in convection? Quantify the hydrostatic relationship b/t warming and surface pressure reduction, vortex spin up and vertical structure. Document warm core asymmetries & relationship to wave number 1, other inner core modes? Possibility of very rapid thermodynamic changes?
- Weakening: Is this preceded by/contemporaneous w/ weakening of warm core aloft? What is the impact of increasing vertical wind shear on warm core structure?
- Extratropical transition: Virtually no in situ data to document this! Asymmetrization of warm anomaly; does cold core develop from bottom up? How long does warm core persist aloft? How is remnant thermal core modified as baroclinic zones develop?

# Use AV-6, AV-1 to Construct In Situ Phase Space Diagrams of Warm Core Evolution Across Storm Trajectory – Unprecedented Temporal Resolution?

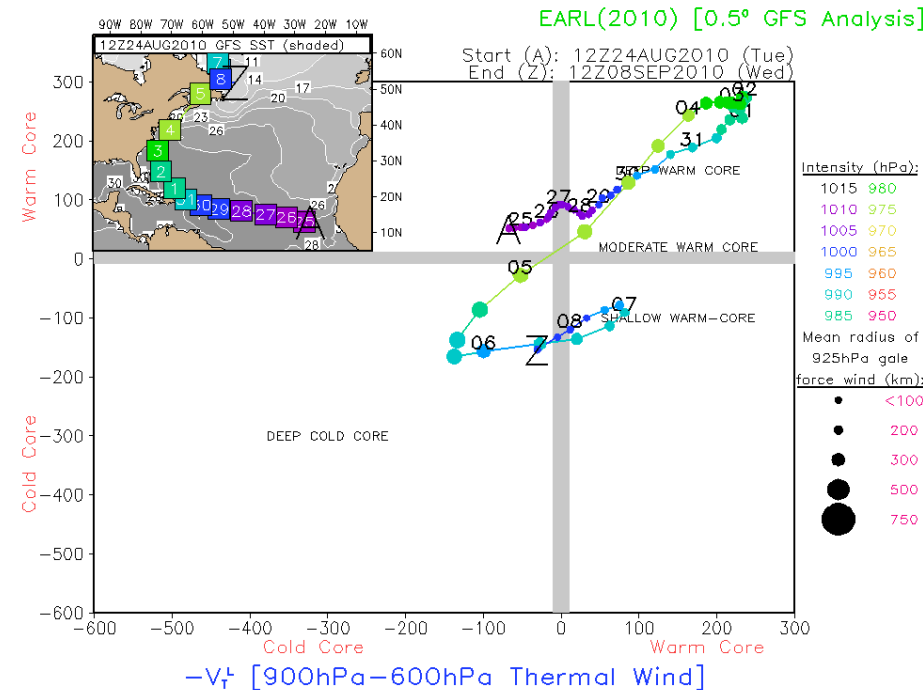
EARL(2010) [0.5° GFS Analysis]

Start (A): 12Z24AUG2010 (Tue)  
End (Z): 12Z08SEP2010 (Wed)



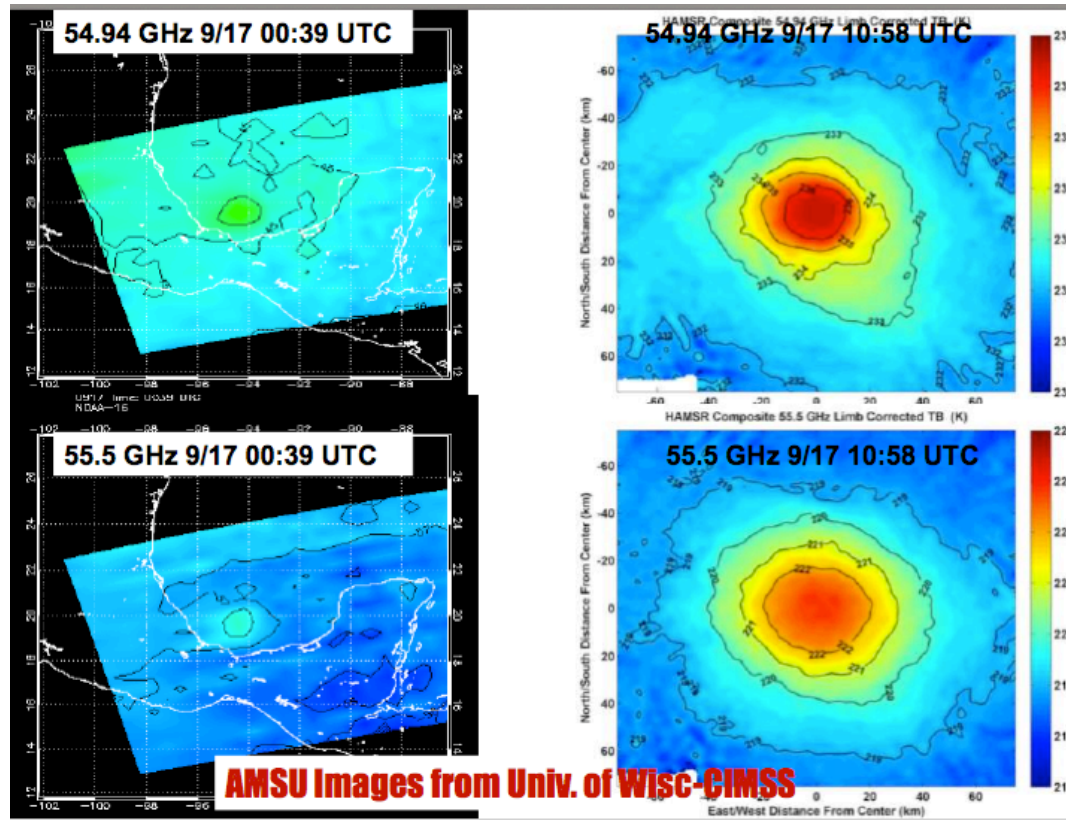
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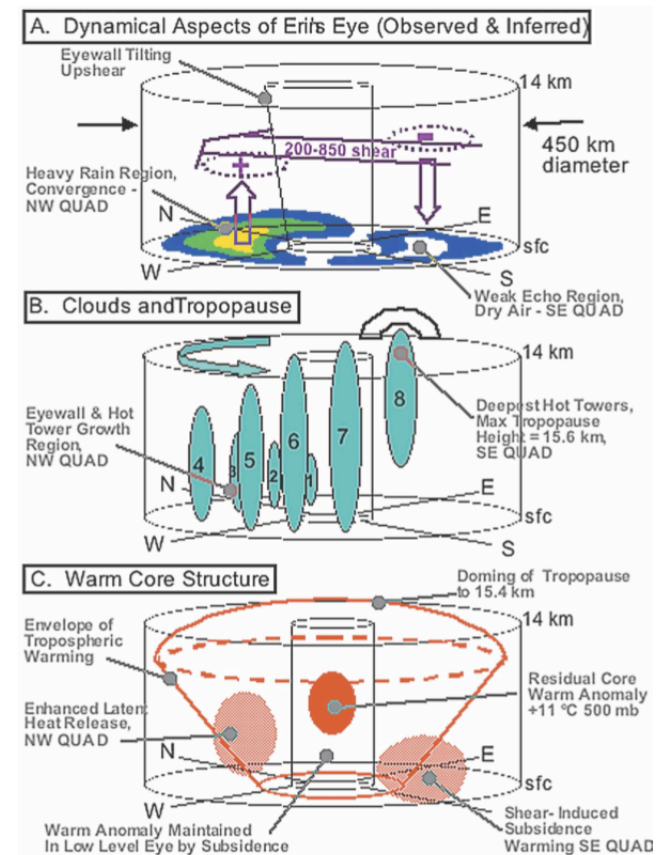
# Continued Comparisons Of In Situ With AMSU Satellite Retrievals Continue to Be Very Important



# How Do We Optimize Warm Core Sampling Strategies?

- Coordination w/ NOAA P3 drops is important
- AV-1: HAMSR provides intensive temporal, spatial warm core sampling, likely 48 hours gap coverage
- AV-6: Can help fill in IF we can get a few storm overflights on each mission – *time continuity of warm core evolution is critical over several days*
- When AV-6 transits inner core, minimum requirement is single, well-placed sonde (this may be difficult) – better to drop a few along transect
- Will need to cross-calibrate HAMSR and dropsonde T, RH profiles for every storm sampled

# Mapping the 4D Warm Core Is a Critical Component of Conceptualizing an Integrated Picture of Each Storm's Behavior & Evolution, Thermodynamics & Kinematics



The more times we can do this during HS3, for a variety of intensities & storm transitions, the better!